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(71) Applicant: KUROSAWA CONSTRUCTION CO., Ltd.
1-36-7 Wakaba-cho
Chofu-shi, Tokyo(JP)

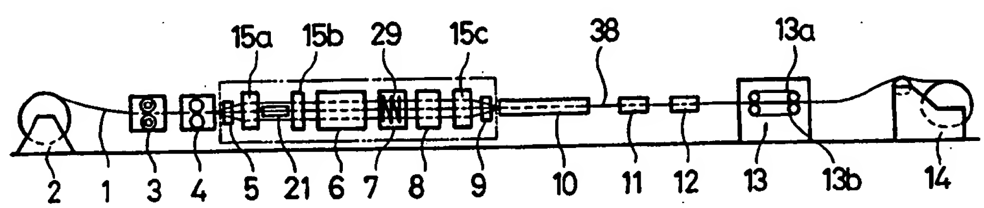
(72) Inventor: Hasui, Takeshi
52, Iichijodori 18-chome
Asahikawa-shi, Hokkaido(JP)
Inventor: Fujikawa, Takatsugu
48-1, Mokougaoka
Ebetsu-shi, Hokkaido(JP)

(74) Representative: VOSSIUS & PARTNER
Siebertstrasse 4
D-81675 München (DE)

(54) Method and apparatus of forming corrosion protection coatings on prestressing strand.

(57) Disclosed is a method of forming corrosion protection coatings on prestressing strands. It comprises the steps of untwisting sequential lengths of a prestressing strand; keeping the surrounding steel wires apart from the core steel wire to coat these steel wires with a synthetic resin; and twisting the coated steel wires to provide a prestressing strand of the original shape, thus permitting the separate coating of each steel wire, leaving, on the prestressing strand surface, the helical dent as deep and wide as the noncoated prestressing strand to assure the bond of the twisted wire to the surrounding concrete as firm as the noncoated prestressing strand. Also, an apparatus for carrying out such coating method is disclosed.

FIG. 1



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The present invention relates to a method and an apparatus of forming corrosion protection coatings on prestressing strand to be used as tensioning member in a prestressed concrete structure, and particularly a method and an apparatus of forming an individually protected strand by synthetic resin coatings.

To bring prestress in concrete with a pre-tensioning method or a post-tensioning method, prestressing strands are used as tensioning members. At present, a prestressing strand is used with no corrosion protection coatings thereon.

Appearance of prestress in the concrete is mainly attributable to the bond between the surrounding concrete and the prestressing strand surfaces, specifically the helical dents of the strand surfaces formed with twisting of the side wires. Therefore, the forming of corrosion protection coatings on prestressing strand will reduce appreciably the width and depth of every helical dent of the strand, accordingly reducing the bond of the strand surfaces to the surrounding concrete.

To prevent reduction of the bond of the prestressing strand surfaces to the surrounding concrete, Japanese Patent 59-130960(A) proposed an "anti-corrosion strand for use in prestressed concrete structure". It discloses a strand which has thick synthetic resin coatings on the strand surfaces and sand particles being blown against the coatings to be partly buried and exposed.

Conventional prestressing strands, however, have anti-corrosion coatings only on their outer surfaces, and no coatings are applied to the spaces between the core steel wire and the surrounding steel wires. If there should be pinholes in the anti-corrosion coating of the prestressing strand, damp air or water would invade inside of the coating through its pinholes, thereby corrosion would occur in the core and surrounding wires inside.

As for the conventional prestressing strand having a sand-buried coating thereon, disadvantageously extra work is required for attaching sand particles on the strand, and if such rough-surfaced strands are gripped and pulled with hands, there is a fear of hurting the hands.

One object of the present invention is to provide a method of forming corrosion protection synthetic resin coatings on prestressing strands, which assures that prestressing strands are prevented from corrosion, and that corrosion protection coated strands can be handled without the fear of hurting the hands.

Another object of the present invention is to provide an apparatus of forming corrosion protection synthetic resin coatings on prestressing strands to assure that the strands are prevented from corrosion, and that corrosion protection strands are handled without the fear of hurting the hands.

To attain these objects a method of forming corrosion protection coatings on prestressing strands according to the present invention comprises the steps of: untwisting sequentially selected lengths of a prestressing strand having a core steel wire and plural surrounding steel wires wound about the core wire; applying pulverized synthetic resin on each of the surrounding and core steel wires of thus untwisted to form coatings on all steel wires; heating and melting such synthetic resin applied to all steel wires; and winding the untwisted sequential length of the resin-coated surrounding steel wires about the core steel wire.

Also, an apparatus of forming corrosion protection coatings on prestressing strands according to the present invention comprises: means for loosening and untwisting sequentially selected lengths of a prestressing strand having a core steel wire and plural surrounding steel wires wound about the core wire; means for applying pulverized synthetic resin on each of the surrounding and core steel wires thus untwisted to form coatings on all steel wires; means for heating and melting such synthetic resin applied to all steel wires; means for cooling the resin-coated surrounding and core steel wires; and means for tightening and winding the untwisted sequential length of the resin-coated surrounding steel wires about the core steel wire.

According to the present invention, sequentially selected lengths of a prestressing strand are untwisted one after another; pulverized synthetic resin is applied on each of the surrounding and core steel wires thus untwisted; such synthetic resin applied to all steel wires is heated and melted; and the resin-coated surrounding steel wires are wound about the core steel wire, whereby all of the core and surrounding steel wires are evenly coated with synthetic resin, providing coatings without reducing the width and depth of each dent of the twisting of the surrounding steel wires about the core steel wire, thus enabling the corrosion protection twisted wires to stick to the surrounding concrete as firm as noncoated twisted wires. Arrangement of resin applying means and heating means between untwisting means and twisting means permits a series of such coating steps to be performed sequentially and continuously.

Other objects and advantages of the present invention will be understood from the following preferred embodiments of the present invention which are shown in accompanying drawings.

Fig.1 shows schematically an apparatus of forming corrosion protection coatings on prestressing strands;

Fig.2 is a cross section of a prestressing strand;

Fig.3 is a front view of loosening-and-untwisting means;

Fig.4 is a side sectional view of loosening-and-untwisting means;

Fig.5 shows schematically a core-length adjuster;

Fig.6 shows the manner in which electrostatic application of pulverized synthetic resin on prestressing strand is effected;

Fig.7 is a cross section of the coated core and surrounding steel wires prior to the twisting of the untwisted and coated wires;

Fig.8 is a side sectional view of tightening-and-twisting means;

Fig.9 is a cross section of prestressing strand having corrosion protection coating on each wire; and

Fig.10 shows another example of tightening-and-twisting means.

A prestressing strand 1 comprises a core steel wire 1a and a plurality of surrounding steel wires 1b helically wound thereabout as shown in Fig.2. A uncoiling stand 2 bearing a coiled lot of such prestressing strand 1 feeds the prestressing strand 1 which is to be coated with a synthetic resin, and a coiling stand 14 at the downstream end to wind the coated strand in the form of coil. Specifically, between the uncoiling stand 2 at the upstream end and the coiling stand 14 at the downstream end there is a pull-out roll 3, a polishing means 4, a loosening-and-untwisting means 5, a coating means 6, a heating means 7, a primary cooling means 8, a tightening-and-twisting means 9, a secondary cooling means 10, a diameter measuring means 11, a pinhole detecting means 12 and a pull-in means 13 in the order named. Wire expanding means 15a, 15b and 15c for keeping the surrounding steel wires 1b apart from the core steel wire 1a of a prestressing strand 1 and a core-length adjusting means 21 are arranged between the loosening-and-untwisting means 5 and the tightening-and-twisting means 9.

The prestressing strand 1 is hauled out from the uncoiling stand 2 by the pull-out roll 3 at a predetermined speed, and the prestressing strand 1 is stretched between the uncoiling stand 2 and the coiling stand 14. The pull-out roll 3 comprises upper and lower rolls 3a and 3b to grip and pull the prestressing strand 1 at a predetermined speed, which corresponds to the speed at which the prestressing strand 1 is fed while being coated with a synthetic resin in the strand coating apparatus.

The prestressing strand 1 is rubbed with wire brushes to remove rust, dust or fat from the prestressing strand 1 in the polishing unit 4. Then, the prestressing strand 1 thus rust removed and cleaned is fed to the loosening-and-untwisting unit 5 so that sequential lengths of prestressing strand 1 are untwisted, and the surrounding steel wires 1b are kept apart from the core steel wire 1a in the first, second and third wire expanding units 15a, 15b and 15c.

As shown in Figs.3 and 4, the loosening-and-untwisting unit 5 comprises a rotary disk 18 rotatably fitted in an annular radial bearing 17, which is fixed to a stationary stand 16. The rotary disk 18 has a core wire guide aperture 20 at its center and a plurality of surrounding wire guide apertures 19 on its circumference. Each guide aperture has a bush 19a or 20a of a hard metal such as alumina to prevent wearing and enlarging of the guide hole.

A sequential selected length of prestressing strand 1 is untwisted by unwinding the end of the prestressing strand and by passing the core wire 1a and the surrounding wires 1b through the center and circumferential guide apertures respectively. As seen from Fig.1, the first and second wire expanders 15a and 15b are placed upstream of the coating unit 6, and the third wire expander 15c is placed between the first cooling unit 8 and the tightening-and-twisting unit 9.

These wire expanders 15a, 15b and 15c have substantially the same structure as the loosening-and-untwisting unit 5, although the wire expanders 15a, 15b and 15c are larger than the loosening-and-untwisting unit 5. Accordingly, the circumferential guide apertures of each wire expander are radially more apart from the center guide aperture than the circumferential guide apertures of the loosening-and-untwisting unit 5.

The core-length adjusting unit 21 is placed between the first wire expander 15a and the second expander 15b. The core-length adjusting unit 21 comprises a stationary sheave 22 and a movable sheave 23, and the movable sheave 23 is spring-biased for instance by a coiled spring 24 so as to be kept apart from the stationary sheave 22. These sheaves 22 and 23 are supported by parallel support rods 25.

The untwisted prestressing strand 1 is fed from the first wire expander 15a and the second expander 15b to the tightening-and-twisting unit 9 through the coating unit 6, the heating unit 7, the primary cooling unit 8 and the third expander 15c, and is subjected to the sequential treatments with the surrounding steel wires kept apart from the core steel wire in these units so that the untwisted and coated wires are twisted in the tightening-and-twisting unit 9 to provide a corrosion protection coated prestressing strand. The coating unit 6 uses, for instance, an electrostatic coating method according to which the core and surrounding wires are coated with pulverized synthetic resin.

As shown in Fig. 6, the coating unit 6 comprises a pulverized synthetic resin feeder 26, a pulverized synthetic resin collector 27 and a dust collector 28. Pulverized synthetic resin carries neg-

ative electricty, and is suspended in the surrounding atmosphere in the coating unit. The untwisted and separated core and surrounding steel wires are grounded and soaked in the suspension of pulverized synthetic resin to attract pulverized synthetic resin onto the core and surrounding steel wire surfaces. The coating thickness can be controlled by controlling the feeding speed of the untwisted steel wires and the feeding amount of pulverized synthetic resin.

After finishing the application of pulverized synthetic resin to the core and surrounding steel wire surfaces, the untwisted steel wires are shifted to the heating unit 7, which preferably uses a high-frequency induction heating means for the sake of facilitating the controlling of temperature. The high-frequency induction heating coil 29 is used to heat the pulverized synthetic resin applied to the core and surrounding steel wires for instance, at 250 °C , thereby melting the pulverized synthetic resin to form corrosion protection coatings 30 on the core and the surrounding steel wires 1a and 1b.

The untwisted steel wires thus coated with synthetic resin are fed to the primary cooling unit 8, in which the wire temperature is reduced to a temperature low enough to cause no problem in the subsequent process. The coating unit 6, the heating unit 7 and the primary cooling unit 8 are separated by partitions 32.

The tightening-and-twisting unit 9 is positioned downstream to the primary cooling unit 8 to wind the surrounding steel wires 1b about the core steel wire 1a. The tightening-and-twisting unit 9 has same structure as the loosening-and-untwisting unit 5, and is used symmetrically with the loosening-and-untwisting unit 5.

As shown in Fig.8, the tightening-and-twisting unit 9 comprises a rotary disk 35 rotatably fitted in an annular radial bearing 34, which is fixed to a stationary stand 33. The rotary disk 35 has a core wire guide aperture 37 at its center and a plurality of surrounding wire guide apertures 36 on its circumference. Each guide aperture has a bush 36a or 37a of a hard metal such as alumina to prevent wearing and enlarging of the guide hole.

The untwisted wires are twisted by passing the core steel wire 1a and the surrounding steel wires 1b through the center and circumferential guide apertures 37 and 36 respectively, thereby setting the surrounding steel wires 1b about the core steel wire 1a so as to wind thereabout. Then, these steel wires are pulled at the wire-feeding rate, and the rotary disk 35 rotates to follow rotation of the wire expander 15c, thereby winding the surrounding steel wires 1b about the core steel wire 1a to provide a prestressing strand.

The wire expander 15c is rotated synchronously with the preceding wire expanders 15a and 15b. The rotation is caused by unwinding the surrounding steel wires 1b in the loosening-and-untwisting unit 5, specifically by forced rotation of the rotary disk 18, which forced rotation is transmitted to all wire expanders 15a, 15b and 15c by the surrounding steel wires 1b. Thus, the rotary disk 35 of the tightening-and-twisting unit 9 rotates in the same direction and at the same speed as the rotary disk 18 of the loosening-and-untwisting unit 5.

As may be understood from the above, sequential lengths of untwisted steel wires are fed through the coating unit 6, the heating unit 7 and the primary cooling unit 8 while the surrounding steel wires 1b are kept apart from the core steel wire 1a by the wire expanders 15a, 15b and 15c and while the surrounding steel wires 1b are rotated by the rotary disk 18 of the untwisting unit 5, the rotation of which rotary disk 18 is transmitted to the following rotary disk 35 of the twisting unit 9. This assures the even formation of corrosion protection coatings 30 (about 200 μ) on the surrounding and core steel wires.

The synchronous rotation of the rotary disks both of the untwisting and twisting units 5 and 9 in same direction assures that the surrounding steel wires are wound about the core steel wire in the same direction in which the surrounding steel wires were wound about the core steel wire prior to the untwisting of the prestressing strand, thus permitting the quick and easy winding of the surrounding steel wires about the core steel wire.

The 200 micron-thick corrosion protection coatings on the core and surrounding steel wires 1a and 1b increase the diameters of these wires accordingly, and the coated, surrounding steel wires 1b must travel an increased circumferential distance about the coated core steel wire 1a, specifically being increased by the circumferential coating thickness of the coated core steel wire. As a result the surrounding steel wires are apparently shortened, and are not long enough that both ends of the surrounding and core steel wires meet when the twisting is finished. According to calculated estimation the core steel wire will have an extra length of about 0.7 millimeters per untwisted length of 1 meter. Assume that a coil of prestressing strand weighing 1 ton is subjected to corrosion protection coating process and that the prestressing strand is about 12.7 millimeters across. The coiled lot of prestressing strand if uncoiled and extended, will be 1,300 meters long, and its core steel 1a wire will have an extra length of 900 millimeters left unwound by the surrounding steel wires.

With a view to adjust the core steel length that both ends of the surrounding and core steel wires meet, the core length adjuster 21 is placed between the first wire expander 15a and the second

wire expander 15b. As seen from Fig.5, the core steel wire 1a extends from the untwisting unit 5 to pass through the wire expander 15a, going downstream around the stationary sheave 22 and coming back upstream around the movable sheave 23, and again going downstream to pass through the wire expander 15b to the coating unit 6.

The core steel wire 1a goes around the stationary sheave 22 and then around the movable sheave 23, which is initially put close to the stationary sheave 22 (phantom lines), and the movable sheave 23 is spring-biased so as to be liable to move apart from the stationary sheave 22, so that the leading length of core steel wire 1a having the surrounding steel wires 1b already wound thereabout may be kept stretched between the untwisting unit 5 and the twisting unit 6 all the time.

With this arrangement an ever increasing extra length of core steel wire 1a will be increasingly pulled backward so that both ends of the surrounding steel wires 1b and the core steel wire 1a meet in the sequential twisted length of coated steel wires. If the traveling distance of the movable sheave 23 is set one meter, the length of core steel wire extending from the movable sheave 23 to the stationary sheave 22 and back to the movable sheave 23 will be two meters long, and will be long enough to permit required adjustment of the presumable extra core length in coating a coiled lot of prestressing strand weighing one ton.

Every time one-ton heavy coiled lot of prestressing strand has been coated, the movable sheave 23 is returned to the initial position (phantom lines), removing the remaining length of core steel wire 1a, and then the coating of another coiled lot of prestressing strand can be started. If it is desired that the preceding coated prestressing strand is connected to the subsequent prestressing strand, which is to be coated, the leading end of the subsequent prestressing strand is untwisted by hand, and likewise the trailing end of the preceding coated prestressing strand is untwisted by hand to pull backward the core steel wire 1a from the untwisting unit 5, causing the movable sheave 23 to move toward the stationary sheave 22 against the coiled spring 24, and cutting the remaining length of core steel wire so that both trailing ends of the surrounding and core steel wires meet, and finally the leading ends of the core and surrounding steel wires of the subsequent prestressing strand are heated and melted to be connected to the trailing ends of the core and surrounding steel wires of the preceding coated, prestressing strand. Thus, continuous processing of sequential coiled lots of prestressing strand is permitted.

The coated prestressing strand 38 is shown in cross section in Fig. 9. It is cooled to normal temperature in the secondary cooling unit 10. Thereafter, the diameter of the coated prestressing strand 38 is measured to make a decision as to whether a required corrosion protection coating is formed.

For instance, the coated prestressing strand 38 is measured in two dimensions, for instance in the X- and Y-axes, and if the measured size should be found out of the permissible range, for instance, ± 50 μ for a 200 micron thick corrosion protection coating, warning signals are generated or the whole system is made to stop.

At the subsequent step a decision is made as to whether the corrosion protection coating 30 has pinholes in the pinhole detector 12, which is of non-contact type, for instance, using an optical detector means. Pinholes if any, are detected, and then, such pinholes are marked; and warning signals are generated or the whole system is made to stop.

The pull-in unit 13 holds the corrosion protection coated prestressing strand 38 between its upper and lower endless belts 13a and 13b, and the pull-in unit 13 hauls in the corrosion protection coated prestressing strand 38, thus allowing the coiling unit 14 to coil the corrosion protection coated prestressing strand 38.

At outset, the whole system must be ready to feed a prestressing strand 1 from the upstream end. The leading end of the prestressing strand 1 is untwisted by hand to pass the surrounding and core steel wires 1b and 1a through the circumferential and center guide apertures 19 and 20 of the rotary disk of the untwisting unit 5, and the leading ends of the untwisted steel wires are drawn to pass to the coiling stand 14 through the coating unit 6, the heating unit 7, the primary cooling unit 8, the twisting unit 9 and the secondary cooling unit 10 while keeping the surrounding steel wires 1b apart from the center core steel wire 1a by the wire expanders 15a, 15b and 15c. Thus, the selected length of untwisted strand may be expanded, coated and twisted to the original shape.

Alternatively a predetermined length of dummy surrounding and core steel wires may be set in the whole system in the same way as just described, although these dummy steel wires start from the downstream end, that is, the coiling stand 14, extending toward the upstream end, that is, toward the wire feeding stand 2. The leading end of the prestressing strand from the uncoiling stand 2 is untwisted by hand to be removed rust and cleaned in the polishing unit 4, and the ends of the surrounding and core steel wires thus cleaned are heated and welded to the ends of the dummy surrounding and core steel wires. Then, the untwisted strand to be coated is made to pass to the coiling stand 14 through the whole system by hauling the dummy wire rope downstream. This alter-

native has the effect of improving the working efficiency.

When the coating of a coiled lot of prestressing strand 1 is almost finished, another coiled lot of prestressing strand 1 is set on the wire feeding stand 2, and the leading end of the prestressing strand 1 is pulled out by the pull-out unit 3 to be removed rust and cleaned in the polishing unit 4. The rust removed and cleaned end of the prestressing strand is untwisted by hand to heat and weld the leading ends of the surrounding and core steel wires to the trailing ends of the surrounding and core steel wires of the preceding prestressing strand, the coating of which is almost finished. Thus, a plurality of coiled lots of prestressing strand can be coated continuously, permitting the whole system to run without intermission. After coating a series of coiled lots may be separated at each welding joint at the coiling unit 14.

In coating a relatively thick prestressing strand, the surrounding and core steel wires are thick enough to transmit rotating power from the untwisted unit 5 to the twisted unit 9 via the wire expanders 15a, 15b and 15c. In coating a relatively thin prestressing strand, however, the surrounding and core steel wires are too thin to transmit rotating power from the untwisted unit 5 to the twisted unit 9 via the wire expanders 15a, 15b and 15c, causing undesired twisting on the way to the twisted unit 9.

With a view to eliminate such undesired twisting, the twisting unit 9 may be equipped with extra drive to rotate its rotary disk 35 as seen from Fig.10. Specifically, a timing pulley 39 is integrally connected to the rotary disk 35 of the twisting unit 9, and the timing pulley 39 is connected to a decelerator 42 by a timing belt 40 and a powder clutch 41, and the decelerator 42 is adapted to be driven by an inverter motor 44 through the agency of an associated drive belt 43.

In operation the inverter motor 44 rotates synchronously with rotation of the rotary disk of the untwisting unit 5 and the feeding speed of the prestressing strand to give a forced rotation to the timing pulley 39 via the decelerator 42, thus causing the rotary disk 35 of the twisting unit 9 to rotate synchronously with the rotary disk 18 of the untwisting unit 5, assuring that the surrounding steel wires 1b are wound about the core steel wire 1a to provide the original twisted wire shape.

The rotating of the twisting rotary disk synchronous with the untwisting rotary disk causes the synchronous rotation of the expanders 15a, 15b and 15c, thus eliminating the possibility of undesired wire twisting, which otherwise, would be caused in case of relatively thin steel wires.

As may be understood from the above, the method of forming corrosion protection coatings on prestressing strands according to the present invention comprises the steps of untwisting sequential lengths of a prestressing strand; keeping the surrounding steel wires apart from the core steel wire to coat these steel wires with a synthetic resin; and twisting the coated steel wires to provide the original shape of prestressing strand, thus permitting the separate coating of each steel wire.

The arrangement of coating unit and heating-and-curing unit between the untwisting unit and the twisting unit permits continuous corrosion protection coating formation on the surface of each steel wire.

The use of core-length adjuster permits both ends of the surrounding and core wires of an elongated wire rope to meet when the required twisting is finished.

Claims

1. Method of forming coatings on prestressing strands comprising the steps of: untwisting sequentially selected lengths of a prestressing strand having a core steel wire and plural surrounding steel wires wound about the core wire; applying pulverized synthetic resin on each of the surrounding and core steel wires thus untwisted; heating and melting such synthetic resin applied to all steel wires; and winding the resin-coated surrounding steel wires about the resin-coated core steel wire.

2. Method of forming coatings on prestressing strands according to claim 1, wherein each sequential length of prestressing strand is untwisted and kept wide radially between adjacent steel wires with the aid of expanding means while pulverized synthetic resin is applied and while pulverized synthetic resin thus applied is heated and melted to form coatings on all steel wires.

3. Method of forming coatings on prestressing strands according to claim 2, wherein untwisting rotation is simultaneously used for twisting operation by converting the untwisting rotation to the twisting rotation via said expanding means.

4. Apparatus of forming coatings on prestressing strands comprising: means for loosening and untwisting sequentially selected lengths of a prestressing strand having a core steel wire and plural surrounding steel wires wound about the core wire; means for applying pulverized synthetic resin on each of the surrounding and core steel wires thus untwisted; means for heating and melting such synthetic resin applied to all steel wires; means for cooling the

resin-coated surrounding and core steel wires; and means for tightening and winding the resin-coated surrounding steel wires about the resin-coated core steel wire.

5. Apparatus of forming coatings on prestressing strands according to claim 4, wherein the loosening-and-untwisting means comprises a rotary disk having a center guide aperture to permit the core steel wire to pass therethrough and a plurality of circumferential guide apertures to permit the surrounding steel wires to pass therethrough, said circumferential guide apertures being arranged on a circle having the center guide aperture as its center.

6. Apparatus of forming coatings on prestressing strands according to claim 5, wherein the loosening-and-untwisting means is structurally similar to the tightening-and-twisting means; and the expanding means is placed between the loosening-and-untwisting means and the tightening-and-twisting means, said expanding means having a core wire guide and surrounding wire guides to keep the surrounding steel wires radially apart from the core steel wire, and a core length adjusting means is placed between the loosening-and-untwisting means and the tightening-and-twisting means, said core length adjusting means having a stationary sheave and a movable sheave, which is spring-biased in a given constant direction.

7. Apparatus of forming coatings on prestressing strands according to claim 6, wherein it further comprises drive means to rotate the tightening-and-twisting means synchronously with the loosening-and-untwisting means in same direction.

FIG. 1

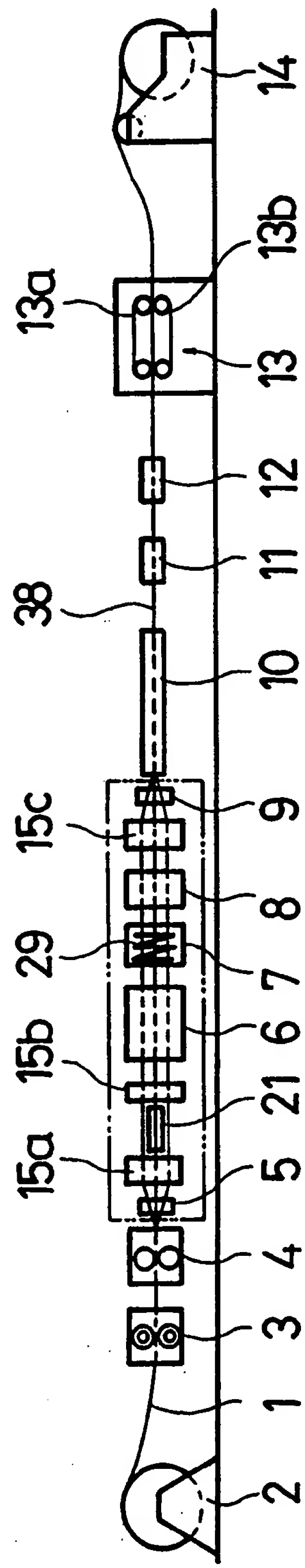


FIG. 2

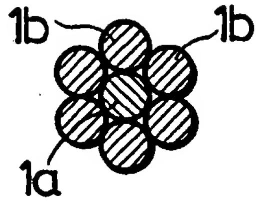


FIG. 3

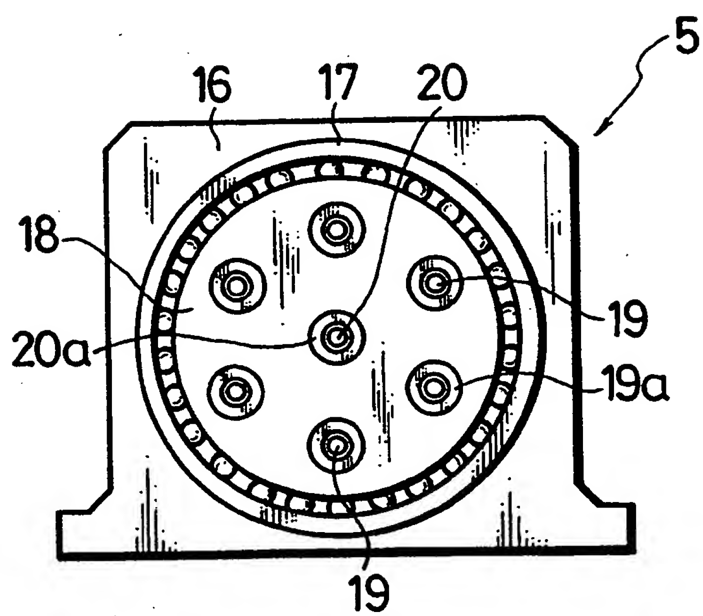
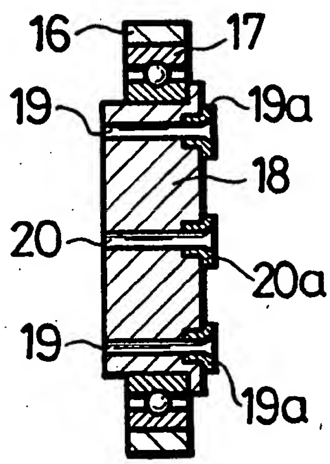


FIG. 4



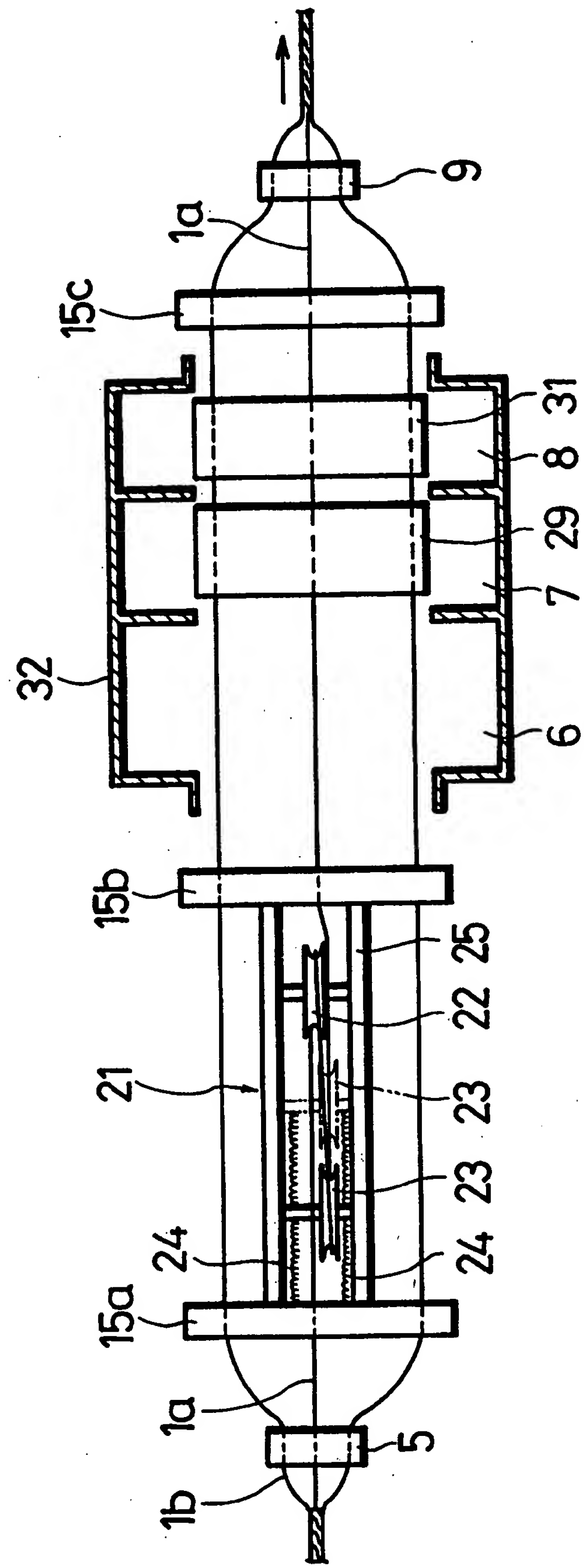


FIG. 5

FIG. 6

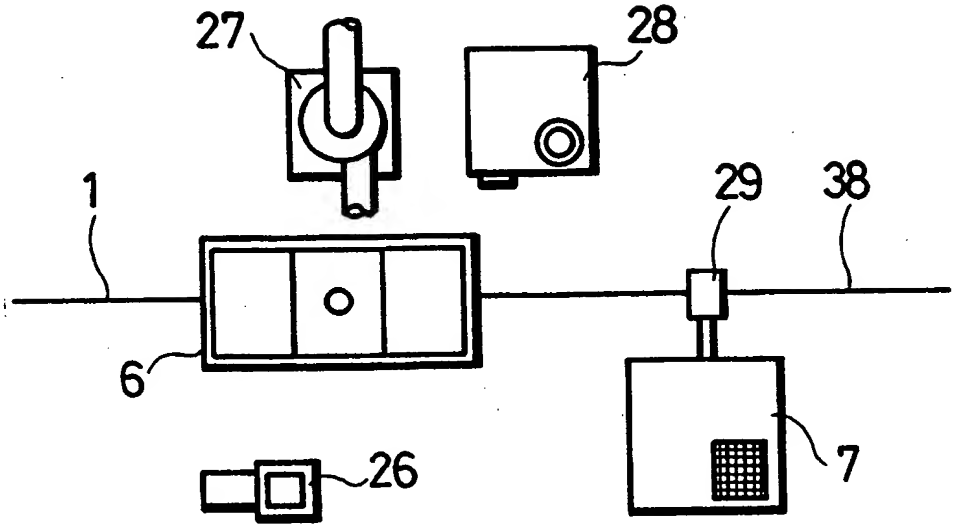


FIG. 7

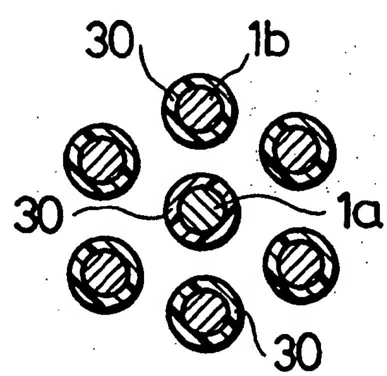


FIG. 8

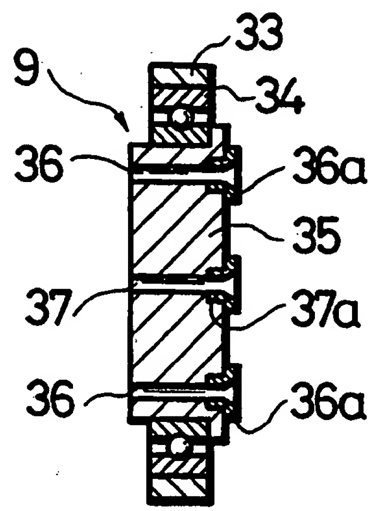


FIG. 9

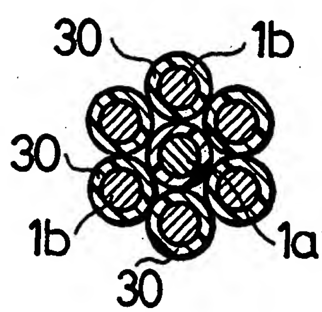
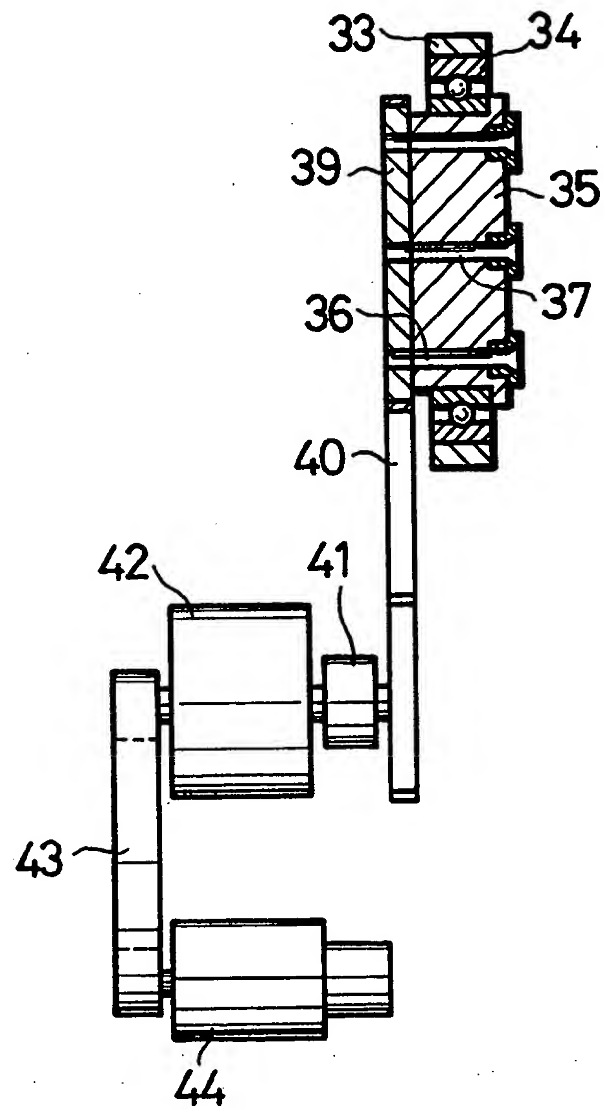


FIG. 10



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 8393

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	WO-A-92 08551 (FLORIDA WIRE AND CABLE CO.) * the whole document * ---	1-7	B05D7/20 D07B7/14
X	US-A-3 972 304 (J.R. BOUCHER) * the whole document * ---	1,4	
A	FR-A-1 128 721 (TREFILERIE ET LAMINOIRS DU HAVRE) * the whole document * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
B05D D07B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 March 1994	Brothier, J-A

CATEGORY OF CITED DOCUMENTS

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